CLAIMS

What is claimed is:

1. A method of communicating optical signals over a free space link, comprising the steps of:

generating an optical beam having a diameter;

transmitting the optical beam over a free space link to impinge on a plurality of receive objectives, wherein the diameter of the optical beam at initial transmission is greater than a sum of diameters of each of the plurality of receive objectives and spacing between the plurality receive objectives such that the optical beam overfills the plurality of receive objectives; and

directing through each of the plurality of receive objectives a portion of the optical beam that impinges on each of the plurality of receive objectives directly into a respective receiver fiber optic core.

2. The method as claimed in claim 1, wherein:

the step of generating the optical beam including collimating the optical beam and limiting the divergence of the optical beam such that the optical beam is substantially non-divergent and has a diameter at transmission of at least 0.1 meters.

3. The method as claimed in claim 2, wherein:

the step of limiting the divergence of the optical beam including limiting the divergence of the optical beam to less than 1.0mr.

4. The method as claimed in claim 2, further comprising the step of:

combining the portions of optical beam from each of the

respective receiver fiber optic cores into a single optical signal.

5. The method as claimed in claim 4, wherein:

performing the steps of transmitting the optical beam, directing the portion of the optical beam and combining the portions of the optical beam all optically and without electro-optical conversion.

6. The method as claimed in claim 4, wherein:

at least one of the respective receiver fiber optic cores is a single mode fiber optic.

7. The method as claimed in claim 4, wherein:

at least one of the respective receiver fiber optic cores is a multi-mode fiber optic having a core diameter less than 100 micrometers.

8. The method as claimed in claim 1, wherein the diameter of the optical beam at transmission is equal to or greater than 0.1 meters.

9. The method as claimed in claim 8, wherein diameters of each of the plurality of receive objectives are between 5 and 100 millimeters.

10. The method as claimed in claim 1, wherein the step of generating the optical beam including generating a plurality of decorrelated optical paths.

11. The method as claimed in claim 1, further comprising the step of:

providing low the angular diversity; and

providing high spatial diversity.

12. The method as claimed in claim 1, further comprising the steps of:

receiving an initial optical signal having a first wavelength;

converting the wavelength of the initial signal to a second wavelength prior to the step of generating the optical beam; and

the step of generating the optical beam including generating the optical beam from the initial signal having the second wavelength.

13. The method as claimed in claim 12, further comprising the step of:

combining the portions of optical beam from each of the respective receiver fiber optic cores into a single optical signal, wherein the single optical signal has a wavelength equal to the second wavelength; and

converting the wavelength of the single optical signal to a third wavelength.

14. The method as claimed in claim 12, wherein:

performing the steps of receiving the optical beam, converting the first wavelength, transmitting the optical beam, and directing the portion of the optical beam all optically.

15. The method as claimed in claim 1, further comprising:

receiving an initial optical signal;

optically adjusting the power of the initial optical signal; and

the step of generating the optical beam including generating the optical beam from the adjusted optical signal.

16. The method as claimed in claim 15, further comprising the step of:

combining the portions of optical beam from each of the

respective receiver fiber optic cores into a single optical signal;

monitoring the power of the single optical signal; and

performing the step of optically adjusting the power of the optical beam if the power of the optical signal is less than a threshold level.

17. A method of communicating optical signals over a free space link, comprising the steps of:

positioning a plurality of receive objectives at one end of a free space link;

receiving an optical beam having a diameter that is at least 0.1 meters, is substantially constant along the free space link and is large enough to overfill the plurality of receive objectives; and

each of the receive objectives directing a portion of the optical beam through the receive objective and into a respective receiver optical fiber.

18. The method as claimed in claim 17, wherein:

the optical beam having a divergence of less than 1.0 mr.

19. The method as claimed in claim 17, wherein:

the respective optical fibers comprise single mode optical fibers.

20. The method as claimed in claim 17, wherein:

the respective optical fibers comprise multi-mode optical fibers having a core diameter less than 100 micrometers.

21. The method as claimed in claim 17, further comprising the step of:

optically combining the portions of optical beam from each of the respective fiber optic cores into a single optical signal.

22. The method as claimed in claim 21, further comprising the step of:

optically coupling the single optical signal into a fiber optic link of a terrestrial optical communication network.

23. An apparatus for optically communicating over free space, comprising:

a transmit objective being configured to optically transmit a collimated optical signal having a low divergence across a free space link;

the transmit objective being optically aligned across the free space link with a plurality of receive objectives that are sized and configured such that the plurality of receive objectives are overfilled by the transmitted optical signal; and

each of the plurality of receive objectives being optically coupled with a respective fiber optic core, wherein the plurality of receive objectives are further configured to optically direct a portion of the transmitted optical signal directly into its respective fiber optic core.

24. The apparatus as claimed in claim 23, wherein:

the transmit objective being configured to optically transmit the collimated optical signal having a divergence of less than 1.5 mr across the free space link.

25. The apparatus as claimed in claim 23, wherein:

each of the receive objectives have an effective focal length of less than 300mm.

26. The apparatus as claimed in claim 23, wherein:

the transmit objective has a diameter sufficiently large to generate the optical signal with a diameter at transmission that is at least 0.1

meters.

27. The apparatus as claimed in claim 26, wherein:

the transmitted optical signal is configured to have a substantially constant diameter across the free space link.

28. The apparatus as claimed in claim 27, further comprising:

each of the respective fiber optics being optically coupled with an optical combiner configured to combine the optical signal from each of the fiber optics to generate a single optical signal.

29. The apparatus as claimed in claim 23, further comprising:

a plurality of transmit optical fibers being optically coupled with the transmit objective, wherein each of the plurality of transmit optical fibers being configured to direct an initial optical signal at the transmit objective such that the transmitted optical signal is based on at least one of the initial optical signals.

30. An apparatus for optically communicating over free space, comprising:

a first transceiver comprising a transmit objective configured to transmit a first optical signal over free space, wherein the first optical signal having a diameter of at least 10 cm when transmitted from the first transceiver and a limited divergence; and

a second transceiver comprising:

a) a plurality of receive objectives configured to receive the first optical signal, wherein the first optical signal has a diameter large enough to overfill at least two receive objectives;

b) each of the plurality of receive objectives being optically coupled with a respective fiber optic conductor, wherein the receive

objectives being configured to focus a portion of the first optical signal impinging on the receive objective into the respective fiber optic conductor; and

c) a second optical signal combiner coupled with the respective fiber optic conductors, the second optical signal combiner being configured to combine the portions of the first optical signal from the respective fiber optic conductors into a first single received optical signal.

31. The apparatus as claimed in claim 28, wherein:

the first transceiver being configured to optically transmit the first optical signal having a divergence of less than 1.0 mr.

32. The apparatus as claimed in claim 29, wherein:

the plurality of receiver objectives have effective focal lengths less than 300 mm.

33. The apparatus as claimed in claim 30, wherein:

the first optical signal is configured to overfill all of the plurality of receive objectives.

34. The apparatus as claimed in claim 30, further comprising:

the second transceiver further comprising a transmit objective configured to transmit a second optical signal having substantially no divergence over the free space; and

the first transceiver further comprising:

a) a plurality of receive objectives configured to receive the second optical signal, wherein the second optical has a diameter large enough to overfill at least two receive objectives of the first transceiver;

b) each of the plurality of receive objectives of the first transceiver being optically coupled with a respective fiber optic conductor,

wherein the receive objectives of the first transceiver being configured to focus a portion of the second optical signal impinging on the receive objective into the respective fiber optic conductor; and

c) the respective fiber optic conductors being coupled with a first optical signal combiner configured to combine the portions of the second optical signal from the respective fiber optic conductors into a second single received optical signal.

35. The apparatus as claimed in claim 34, further comprising:

the second transceiver further comprising a second beacon configured to receive the first optical signal; and

the second beacon being coupled with a power controller configured to determine a power of the first optical signal and to adjust a power level of the second optical signal based on the power of the first optical signal.

36. The apparatus as claimed in claim 30, further comprising:

the second transceiver further comprising a second beacon configured to receive the first optical signal and to sense the position of the first transceiver; and

the second beacon being coupled with a second controller configured to receive position information from the beacon and to maintain optical alignment between the first and second transceivers based on the position information.

37. The apparatus as claimed in claim 30, further comprising:

the first transceiver further comprising a first beacon configured to transmit a tracking signal over the free space;

the second transceiver further comprising a second beacon configured to receive the tracking signal and to sense the position of the first

transceiver based on the received tracking signal; and

the second beacon being coupled with a second controller configured to receive position information from the second beacon and to maintain optical alignment between the first and second transceivers based on the position information.

38. The apparatus as claimed in claim 30, further comprising:

the first optical signal have a first wavelength; and

the second transceiver further comprising a second wavelength transformer coupled with the second optical signal combiner, the second wavelength transformer being configured to optically transform the first single received optical signal to a second wavelength.

39. The apparatus as claimed in claim 38, further comprising:

a transmit optical conductor being coupled with the first transceiver, and configured to supply an initial optical signal having a third wavelength; and

the first transceiver further comprising a first optical wavelength transformer configured to receive the initial optical signal and to optically transform the third wavelength to the first wavelength prior to the first transceiver transmitting the first optical signal.

40. The apparatus as claimed in claim 30, further comprising:

the second transceiver further comprising a second beacon configured to receive the first optical signal; and

the second beacon being coupled with a power controller configured to determine a power of the first optical signal and to signal the first transceiver to adjust the power level of the first optical signal.

41. The apparatus as claimed in claim 30, further comprising:

the second transceiver being coupled with a terrestrial optical communication network, wherein the second transceiver optically couples the first single received optical signal into a fiber optic link of the terrestrial optical communication network.